

A BUSINESSMAN'S VIEW

STATINTL

ON THE "FAILURE" OF EDUCATION

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A California industrialist, looking into a shortage of trained men, comes up with these conclusions about American education:

- Students are getting fewer and fewer courses that train them to think clearly.
- "Socialist" influences are resulting in a curbing of healthy competitive spirit.

- Modern schools are so "geared to mediocrity" that bright students are discouraged.

- Many teachers are incompetent in the courses they teach, and fail to inspire.

- As a result of such trends, thousands of high-school graduates are "woefully unqualified" for advanced training in college.

by Dr. Arnold O. Beckman

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In March of this year the congressional Joint Committee on Atomic Energy published an authoritative and disturbing report on "Engineering and Scientific Manpower in the United States, Western Europe and Soviet Russia." Statistics cited in this report showing the number of engineers and scientists in our country and in the Soviet Union should destroy any feeling of complacency we might have concerning the superiority of the United States in science and technology. They point up the need for immediate and effective action if we are to provide adequately for our national security and maintain a leading position in the future in scientific discovery and technological development.

In 1954, Russia had more than 540,000 engineers, plus about 160,000 scientists in educational and research institutions, a total of 700,000. In the United States there are between 700,000 and 750,000 actively employed engineers and scientists. At the moment, therefore, we are about on par with Russia.

This fact may come as a shock to many of us who are accustomed to think of Russia as a backward country. Even more shocking is a study of the trends in technical education in this country and in Russia. From 1900 to 1950, engineering and scientific professional graduates in the United States increased almost twice as fast as did the population. Since 1950 there has been a sharp decline: 52,732 first professional or bachelor's engineering degrees were granted in 1950; in 1954 there were only 22,236 such degrees. Sixty-one thousand and one similar degrees were granted in natural sciences in 1950; in 1954, only 31,168. Despite the increase in total population during this period, and the increased demand for engineers and scientists by new

technologies and greatly increased emphasis upon research, the annual crop of technical graduates decreased by more than 50 per cent!

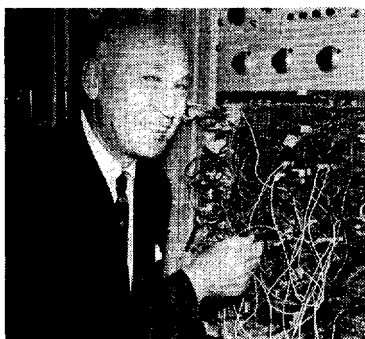
Contrast this situation with what has been taking place in Russia. In 1950 there were 28,000 engineering degrees awarded in Russia. In 1954 the number had nearly doubled, being 53,000. For 1955 the number is estimated at 63,000—a figure to be compared with only 23,000 similar degrees for the United States!

Over the last five years we have turned out only 142,000 engineers, compared to an estimated 216,000 in Russia.

Allen W. Dulles, Director of the Central Intelligence Agency, has summed up the situation with a prophecy for the decade 1950-60. The Soviets will graduate 1.2 million in the sciences, while the United States will graduate 900,000. He said, "Unless we quickly take new measures to increase our facilities for scientific education, Soviet scientific manpower in key areas may well outnumber ours in the next decade."

The latest available engineering enrollments show that the United States has one engineering student for every 974,000 of its total population. Russia has one to every 725,000. The population of Russia is one-third greater than that of the United States.

There is no comfort to be gained from the hope that the quality of Soviet training is inferior to ours. Russian university students start out with more intensive mathematical and scientific preparation at the high-school level. They study harder and longer in college. The Joint Committee report states that, because of the emphasis on science and the vigorous scholastic competition in the Soviet educational system, Soviet



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... "Many science teachers are not interested in science"

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graduates are professionally as competent as scientific graduates in the United States.

Science predominates in Russian higher education. More than half of all Russian university graduates are in the fields of science and mathematics; only a fifth of the U. S. graduates are in these fields. Russian Ph.D.'s, or the equivalent, are 3 to 1 in favor of science and engineering, in comparison with 1 to 3 for the United States.

Why has our country failed to provide the number of technical graduates it needs? With a current need of 35,000 to 50,000 new engineers per year, why have our schools provided only a little over 22,000 each year for the past two years? In my opinion, the blame rests squarely on our public-education system—especially at the high-school and elementary levels.

In what ways has our education system failed? First, it has failed to anticipate and prepare for the steadily increasing need for more scientists and engineers. An essential function in any big business is to forecast future needs for its products and to anticipate, and be prepared for, changes in its output to meet the changing needs of the times. We should not forget that education is big business. Of the 1.8-billion-dollar 1955-56 California State budget, 38 per cent, or 784 million dollars, is for education. This is big business, and we, as taxpayers, have a right to expect that our public-education business will be operated as efficiently as other businesses.

Public utilities and large manufacturing companies are constantly engaged in market surveys, studies of trends, etc. They accept without question the responsibility for seeing that telephones, electricity and manufactured products of all kinds are provided when and where needed. Our public-education system has an equal responsibility to anticipate the needs for its product—trained students—in the quantities required and with skills necessary to meet the needs. This is an essential part of the business of education. The job has not been well done.

Studies Get Easier

Our education system appears to have failed in another serious way, namely, by permitting progressive deterioration in the rigor of its mental training and disciplines. Our elementary and high schools appear to suffer from what might be described as pernicious softening of the curriculum. Over the past two or three decades there has been a marked decline in the number of students required to take subjects such as mathematics, physics and chemistry, which demand and develop clear thinking and analytical reasoning.

At the beginning of the century, 1 in every 5 high-school students studied physics; today only 1 out of about 25 throughout the nation. In place of basic courses in mathematics and science, students have been permitted to choose elective courses which fail to provide an adequate foundation for college work in any field of engineering or science. The result is that our high schools have been turning out thousands of students woefully unqualified to undertake college-level studies in technical fields.

One explanation which has been advanced for the shortage of technical graduates from our universities is the inadequate number of university professors. It is said that our universities are losing professors to industry, because of higher salaries paid by industry. Whether or not this is true to a significant extent appears to have little bearing on the technical manpower problem. There is no evidence that university students are denied training in science and engineering because of an insufficient number of university professors or inadequate

laboratory or classroom facilities. The technical manpower problem arises from the fact that too few students enter colleges and universities who are interested in, and are prepared to follow, careers in science and engineering.

The failure of our elementary and high schools to inspire students to enter technical fields and to train them properly for technical careers is reflected in the statistics of university graduates. In 1950, graduates in engineering and science in the United States represented 25 per cent of the entire graduating class. In 1954, they represented 18 per cent, and the forecast is that the class of 1960 will have not more than 15 per cent of its graduates in engineering and science.

Interest in Science "Killed Off"

This situation does not represent a crisis which developed suddenly. It is the inevitable result of a long history of declining interest at the high-school level in subjects such as mathematics, chemistry and physics, which are basic to engineering and science. It is amazing that this decline should have occurred at a time when the interest of young students in new scientific developments has been at an all-time high. Even some of the most popular comic strips for children are based on pseudoscientific subjects, involving space travel, death rays, etc. How have our teachers managed to kill off this interest?

There are several explanations. One is that many science teachers are not interested in science, nor are they competent to teach science. A personal experience drove home this fact to me a number of years ago when a competitive examination, with university scholarships as prizes, was sponsored by a local section of the American Chemical Society. I was amazed by the number of high-school teachers who asked for sets of the correct answers so that they could discuss the examination later with their students! An investigation showed that 30 per cent of the high-school chemistry teachers had taken no university courses in chemistry. There is little reason to believe that the situation is much different today.

Last November, Lewis L. Strauss, Chairman of the U. S. Atomic Energy Commission, in commenting upon an analogous situation, stated: "A survey of 30 States showed that about 1,800 new mathematics teachers were urgently needed, but 700 of the positions had to be filled with unqualified persons, including instructors in such unrelated subjects as music, home economics and physical culture."

A recent issue of "Time" magazine reports a year-long survey of instruction in high-school mathematics, which was financed by the Carnegie Corporation of New York and conducted by the well-known Educational Testing Service of Princeton, N. J. The survey showed that the teaching of mathematics is in a deplorable state. A large number of elementary-mathematics teachers not only did not know how to teach the subject effectively but were barely able to keep ahead of their pupils. In a survey of 211 prospective elementary teachers, 150 reported "a long-standing hatred of arithmetic."

High-school teaching is so bad that 62 per cent of colleges surveyed reported a necessity to repeat high-school mathematics in college. The math situation is so bad in secondary schools that five years ago Annapolis abolished trigonometry as an entrance requirement, began to teach it itself.

"Elementary teachers, for the most part," according to one observer who has taught them, "are ignorant of the mathematical basis of arithmetic; high-school teachers . . . fall in this category also. This ignorance is scarcely surprising, for little knowledge of mathematics is expected, even officially, of prospective schoolteachers. In the majority of cases, an in-

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dividual with ambition to teach in an elementary school can matriculate at a teachers' college without showing any high-school mathematics on his record. He can be graduated without studying any college mathematics. And, in this condition, he can meet the requirements of most States for a certificate to teach arithmetic . . . Nearly one third of the States will license (high-school math) teachers—even though they have had no college mathematics at all, and the average requirement for all States is only 10 semester hours."

The whole situation, says Educational Testing Service, finally boils down to this: "Future teachers pass through the elementary schools learning to detest mathematics. They drop it in high school as early as possible. They avoid it in teachers' college because it is not required. They return to the elementary school to teach a new generation to detest it."

"Incompetence" of Teachers

The alarming spread of teacher incompetence throughout our public-school system reflects the powerful influence of teachers' colleges and certain teacher organizations which have succeeded, over the years, in establishing regulations and practices which may be to their interests but are not necessarily beneficial to education. Rigid restrictions governing teaching credentials, which purportedly guarantee a measure of competence, actually do nothing of the kind, as surveys have shown. These restrictions, based largely on exposure to certain courses in methods of teaching, have little to do with a person's effectiveness as an inspiring and effective teacher.

To the extent that teaching-credential restrictions are arbitrary and unrealistic, they injure rather than aid the teaching profession. The Committee for the 1955 White House Conference on Education, in its report to President Eisenhower, stated: "Teacher-preparation programs have the reputation of requiring needless and repetitious courses. This reputation has the effect of deterring brilliant young people from becoming teachers."

Not only are brilliant young people deterred from becoming teachers, and thus aiding in relieving the shortage of competent teachers, the arbitrary restrictions prohibit many able persons from teaching in our public schools. Does it not strike you as strange that leading professors in science at famous universities, such as the University of California and Stanford University, are not qualified to teach their subjects in our high schools, yet a high-school drama or music teacher with no training in science may do so!

If unreasonable restrictions on teacher qualifications were eliminated, hundreds of competent teachers in mathematics, science and engineering would be available from industry on a part-time basis—teachers of the kind needed now, teachers who can inspire students to enter technical fields because they can speak from firsthand experience of the challenge and opportunities of their profession. George Bernard Shaw is reputed to have said, "Those who can, do. Those who can't, teach." This cynical comment is unfair to the thousands of capable teachers who are dedicated to their profession, but it does suggest that those who are "doing" might indeed add something to teaching—that something which might inspire young Johnnie to become a future Einstein.

Many able educators have cried out against onerous policies and practices in public education which have been established largely through the influence of teachers' colleges. This is an involved matter. I will merely point out here that a major criticism has been the overemphasis on methods of teaching versus the underemphasis on knowledge of the subject being taught. The late Dr. Robert A. Millikan fought this battle at the University of Chicago many years ago. He

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SCIENCE IS THE BIG THING IN RUSSIA



BIOLOGY STUDENTS USE ELABORATE TEST EQUIPMENT



HURRYING TO A LECTURE AT THE MOSCOW UNIVERSITY



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IN CLASSROOM, RUSSIAN SCIENCE STUDENTS TAKE NOTES

"Soviet graduates are as competent as in the U. S."

... "The broad socialistic movement shows up in schools"

insisted that teachers of physics know something about physics and not merely have taken courses in the methods of teaching. Within the last few months, Dr. Wallace Sterling, president of Stanford University, also decried the fact that many of our teachers today are more concerned with the methods of teaching than with teaching.

I have been interested in education most of my life: as a student, a university teacher, a parent, an employer and a taxpayer. During the 14 years I was engaged in teaching at the California Institute of Technology, I had the opportunity to become well acquainted with the product of our high schools and to learn something about our public-school system. Many things have been happening to public education which bother me greatly. While obviously there are many factors which have contributed to our present educational problems, I believe that there are certain trends which are most important.

The Fight Over Grading in Schools

Some of these are the trends of the times. The broad socialistic movement, which has engulfed our country as well as other countries, which tends to destroy competition, eliminate free enterprise and destroy individual initiative, shows up in our school system in several ways.

One is the attempt to do away with a competitive grading system in our public schools. In certain schools, grades which showed comparative performances of pupils, or measured their skills, were eliminated. Some schools even went so far as to attempt to grade pupils not on their performance in an absolute sense but upon their performance in relation to their estimated ability, as measured by an I.Q. test or some other means. On the basis of this standard, a moron who handed in all of his home work—even though it was worthless—would receive a higher grade than a brilliant student who was somewhat careless in turning in his papers.

In some school districts where indignant parents have demanded that grades be re-established, the attempt is made to minimize the significance of grades denoting proficiency, by having several other grades for each course. In arithmetic, for example, there are grades which purportedly measure such things as "responsibility and self-direction, and relationships with others." Much of this educational tomfoolery can be credited to the unfortunate influence of certain groups in our educational system, such as so-called "progressive educators," who, unfortunately, before aroused parents found what was going on and demanded a change, injured untold thousands of our youth through the imposition of educational procedures based upon immature theories of a few educational cultists.

The swing away from progressive education is an encouraging sign that improvements are under way. We should not be misled, however, for, to a large extent, the same group of educators which permitted "progressive education" to infiltrate our public schools is still in charge. The same people are tinkering with our educational machinery—often apparently without any clear understanding of what their objectives are or should be.

Several years ago the national American Chemical Society took the lead in fighting a move to emasculate rigorous scientific instruction by eliminating specific courses in physics, chemistry and biology, and substituting a course in general science. Educators stated that nature embraces all science; that the division into separate fields, such as chemistry and physics, is entirely arbitrary and therefore should be eliminated. While this may be an interesting subject for

an argument, the fact was that the courses in general science which were offered failed to provide fundamental training in any field of science.

There is a heavy student loss between high school and college graduation. The Joint AEC Committee report states: "Of all high-school graduates whose qualifications are such as to warrant their striving to become engineers and scientists, about one half cease further schooling to go into the business of earning a livelihood. Of the half who go on to college, only about 40 per cent graduate. Thus, of every 10 high-school pupils with capacities for potential careers in engineering or science, only two graduate from college. From there on, the attrition is even greater, for of all college graduates less than 3 per cent continue their studies to earn a Ph.D. degree."

Recently there has been a rush on the part of certain large industries to provide scholarship funds. This action is based, presumably, upon the belief that lack of finances is a chief cause for the loss of technical students after high school. The providing of scholarship funds is a splendid thing, and should be encouraged. I do not believe, however, that the availability of new funds will solve the problem, at least with respect to top students. Any able student can finance himself through college today.

What can be done to improve the situation? It is obvious that more of our youth must become interested in science and engineering, and must be provided with educational opportunities for proper rigorous training in these fields. The first step is to interest the student. Inspiration can come only from enthusiastic, competent teachers. Teachers untrained in a subject should not be permitted to teach that subject—regardless of the number of courses he or she may have taken in so-called pedagogy. Incompetent teachers must be weeded out.

Teachers Who Can't Be Ousted

The teachers' tenure system should be investigated. The tenure plan was instituted, I understand, as a method of taking politics out of teaching. A teacher with three years' full-time teaching acquires tenure status. This means that, thereafter, it is virtually impossible to discharge a teacher, except for very grave charges of misconduct or something of equally serious nature. Any obligation on the teacher's part to be an effective teacher during the long period of guaranteed employment is vague and usually amounts, at most, to attendance at a few lectures or an occasional summer-school course.

There is no yardstick by which a person's effectiveness as a teacher is measured. To the best of my knowledge, the routine rating of teachers on the basis of their actual effectiveness in the classroom is something which is not attempted. Why not? I can see no reason a teacher should be permitted to remain on a job when he fails to perform satisfactorily. The working of the tenure principle should be carefully studied to make sure that it gives reasonable security to teachers on the one hand, but, on the other hand, that it gives corresponding assurance to parents that their children will not be subjected to education by incompetent teachers.

Merit rating for teachers is receiving attention from some school boards and other agencies interested in the quality of teaching. In the May, 1956, issue of the "Tax Digest," E. Maxwell Benton, educational counselor for the California Taxpayers Association, states: "Considerable criticism is developing of teacher-salary schedules which use only the two yardsticks, college training and teaching experience, for deter-

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... Schools teach "a great deal of educational rubbish"

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mining salaries. There is a growing conviction that teacher salaries should also be related to the quality of instruction."

He points out that the prevalent automatic advancement plan by which the mediocre teacher advances at the same rate as the outstanding teacher lowers the prestige of the teaching profession and discourages able teachers. He quotes the "American School Board Journal," May, 1954: "Union protection, automatic increments, indefinite tenure—these safeguards attract a certain type of person into the teaching profession. True leaders, people who 'have it on the ball,' do not search for positions offering such safeguards."

Incentives for Instructors

Proponents of merit rating contend that the practice of paying teachers what they are worth, rather than rewarding them merely for becoming older teachers, would bring about a great improvement in teaching. Merit programs would tend to draw and hold superior teachers. Acting upon the recommendation of a Citizens Advisory Committee, the Pasadena (Calif.) school board is now working on a procedure for formal evaluation of current job performance which will be a part of its teachers' salary-schedule code. As the idea spreads, we may hope for improvement in the quality of teaching in elementary and secondary schools.

The curriculum of secondary and elementary schools should be under constant study, and should be revised when necessary to reflect current needs. The tremendous advances in science in recent years have created, and will continue to create in the future, vast amounts of new knowledge which must be taught. How can this new information be worked into a curriculum which is considered to be overcrowded today? Several things can be done. Much subject matter of today's elementary and high-school curricula could be eliminated advantageously. There is a great deal of educational rubbish and scholastic trivia in our present curricula.

Many subjects could be taught at an earlier age. Why should foreign languages, for example, be retained for the later years? These can be taught just as well, and possibly more readily, in the early years.

Our curricula today are largely the result of tradition. They are the carry-over of past generations in which classical education predominated. I think it is time that a fresh look be taken by unprejudiced, imaginative and able educators, persons who can throw off the shackles of blind adherence to tradition. Let these persons look at the world as it is today and ask themselves, "What knowledge, what training, what skills does the youth of today need to prepare him best for the problems he will encounter in his lifetime?"

The answer will be a sensible, realistic course of study which, by comparison with our present curricula, would show that we are now wasting tremendous amounts of time on subjects of little value. We are dulling the interests of many potential scientific leaders by failing to provide courses, as well as teachers, which would inspire them to enter professions in which their abilities can be used most beneficially.

One weakness of our public-school system is the attempt to confine students of all kinds in the same classroom. Observant educators have noted that it is "impossible for a small corps of teachers to serve both terminal and college-preparatory students with vital, relevant, inspiring work in the range of subjects needed by both groups." There is evidence that some of our junior colleges stress terminal courses—to the detriment of the student aspiring to enter college.

In a commencement address, Dr. Frank Baxter, noted

Shakespearean professor at the University of Southern California, suggested that it was high time that our public schools stop putting all students through the same mill; that we may be wasting one of our most valuable national resources when we fail to develop to their fullest extent the talents of students having superior ability; and that these talents cannot be developed favorably in an educational system geared to mediocrity.

There was an immediate reaction to the suggestion that superior ability be recognized and cultivated in our public schools. "It's un-American," said one. "It violates the principle of equal rights for all!" Such shallow thinking overlooks the fact that there is no greater inequality than the equal treatment of unequals.

In these remarks I have stressed certain weaknesses and shortcomings of our public-education system. I have deliberately refrained from discussing the good features, and



—USN&WR Photo

AN AMERICAN CLASS IN GEOMETRY—"The teaching of mathematics is in a deplorable state"

there are many, for my primary purpose was to indicate areas in which improvement is needed and to suggest some ways in which improvements can be made. I hope that no one will construe the critical nature of my remarks as an indication of lack of faith in our system of public education, nor lack of confidence in our public-school teachers.

Public education is a magnificent institution—I wish to make it still better. We are fortunate in having in our public schools many able, inspiring teachers who are dedicated to their profession. I have the greatest respect for them. My wish is to see their ability recognized and their burden lightened by providing them with able associates.

It is my hope that civic organizations throughout the nation will take a more active interest in public education, and will do their utmost to end the current wastage of potential technical manpower—before it is too late.

Foregoing is an excerpt from an address by Dr. Beckman before the Los Angeles Chamber of Commerce on June 22, 1956.